

Draft Proposed Retrofit Verification Protocol for Off-Road LSI Engines

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California Environmental Protection Agency



Air Resources Board

Background

- ◆ Verification needed to ensure emission reductions are real and durable
- ◆ Verification needed to sell/install retrofit emission systems in California
- ◆ Currently - No LSI retrofit verification protocol available

Overview

- ◆ Applicability
- ◆ Application Process
- ◆ Verification Testing Requirements
- ◆ In-Use Compliance Testing Requirements
- ◆ Other Requirements
- ◆ Warranty Requirements

Applicability

- ◆ Retrofit systems for off-road LSI engines
- ◆ Applicable to any fuel (LPG, gasoline, CNG...)
- ◆ Examples of equipment employing off-road LSI engines: Forklifts, sweepers, generator sets, tractors, construction equipment

Application Process

- ◆ Submit application
 - Identify level of verification
 - Describe retrofit system
 - Define emission control group
 - Describe plans for conducting emission tests (initial, durability, in-use compliance)
 - Describe field demonstration plan
 - Provide warranty information

Retrofit System Verification Classifications

LSI Engine Retrofit System Verification Classifications and Levels

Classification	Level 1 (NO _x +HC)	Level 2 (NO _x +HC)
Percentage Reduction	25% - 75%	≥75%
Absolute Emission Level	3.5 -9.0 g/bhp-hr	≤ 3.0 g/bhp-hr

Note: The minimum emission reduction required for any pollutant, NO_x or HC, is 15 percent from baseline values

Emission Control Group

- ◆ Emission control group
 - A set of engine parameters and/or operating conditions that affect performance of retrofit system (established by the applicant)
 - Could comprise different engine families, engine models and makes
- ◆ Verification granted on the basis of emission control group

Verification Testing Requirements

- ◆ Initial Emission Testing
- ◆ Durability Emission Testing

Initial Emission Testing

Test Cycles

Test Cycles for Emission Reduction Testing

Test Type	LSI Retrofit System Verification Date	Off-Road (including portable engines)	Off-Road (constant-speed operation)
Engine	Pre-2007	Steady-state test cycle (C2) from ARB off-road regulations or U.S. EPA transient test	Steady-state test cycle (D2) from ARB off-road regulations or U.S. EPA transient test
Engine	2007 and later	U.S. EPA transient test	U.S. EPA transient test

Durability Emission Testing

- ◆ Durability period: 2,500 hours
- ◆ Field or laboratory durability demonstration allowed
- ◆ Initial and final tests required over durability period
- ◆ Use same test cycle(s) as used for initial emission verification testing

In-Use Compliance Testing

- ◆ To ensure that retrofit systems sold to end-users function as effectively as when tested for verification
- ◆ Required after 50 units have been sold in CA
- ◆ Minimum of four retrofit systems to be tested

In-Use Compliance Test Cycle(s)

- ◆ Laboratory
 - Remove engine and test in laboratory
 - Use same test cycles as used for initial verification emission test
- ◆ In-field
 - Test engine while installed in equipment
 - Must follow U.S. EPA field testing procedures (40 CFR, part 1065, subpart J)
 - Must correlate to engine dynamometer data
- ◆ Alternative In-Use Test Procedure
 - Must be approved by ARB

Other Requirements

- ◆ Field Demonstration
 - Evaluate retrofit system compatibility
 - Satisfy durability requirements for laboratory-based durability testing
- ◆ Retrofit System Labeling
- ◆ Owner's Manual
 - Installation, maintenance instructions
 - Warranty statement

Warranty Requirements

- ◆ Product Warranty
 - Applies to manufacturers of retrofit systems
 - 3 years or 2,500 hours
- ◆ Warranty Coverage
 - Emission performance over 2,500 hrs
 - Repair or replacement cost of retrofit system
 - Repair or replacement cost of engine components damaged by retrofit system
- ◆ Warranty Exclusions
 - Engine/retrofit system was neglected, abused or improperly maintained

Warranty Requirements (cont.)

- ◆ Installation Warranty
 - Applies to installers of retrofit systems
 - 3 years or 2,500 hours
 - Installation is free from defects - workmanship or materials
- ◆ Warranty coverage and exclusions: same as for retrofit system manufacturers

FOR MORE INFORMATION

LSI Draft Retrofit Verification Protocol website address:

<http://www.arb.ca.gov/msprog/offroad/orspark/wrkgroup/wrkgroup.htm>

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